# Space Weather Technical Forecast

Issued on Thursday, 18 April 2024 at 13:16 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

**Space Weather Forecast Headline: Further M-flares likely and a slight chance of X-flares. Slight chance of G1/Minor Storm conditions day 3 (20 Apr) due to high speed stream from a negative coronal hole.**

**Solar Activity:** Activity is currently Moderate, with largest flare an M2.2 event, which peaked at 18/0248 UTC from AR3638 in the southeast. Background flux is well within C-class levels. There are currently fourteen sunspot regions on the visible disc with a new, small bipolar region recently emerged to the west of AR3646 in the northeast. AR3645 is now the largest region on the disc, with both an increase in penumbral extent and additional spots having developed, with a delta spot emerging within its intermediate portion. The region lies in a cluster of sunspots that appear to be magnetically connected, enhancing complexity and susceptibility to significant flaring. AR3639 in the northeast is the second largest region on the disc, which appears to have lost its delta spot within its intermediate portion. The remaining regions appear generally stable with little change since the previous analysis.

A filament eruption was observed around 17/0200 UTC lifting off in the northern hemisphere, although unlikely to have any Earth-directed component as the bulk of material appears to be heading north away from the Earth-Sun line. Meanwhile, further CMEs were observed from an area near AR3638 late on 17 Apr and early on 18 Apr. These may have a minor Earth-directed component(s), which have been analysed and would only be expected to be observed as weak transients on 21 or 22 Apr. Low confidence.

**Solar Wind / Geomagnetic Activity:** Solar wind parameters were indicative of minor CME influence during the period. Solar winds as observed by ACE at L1 were mostly slow-ambient, but briefly reached slightly elevated levels, with a peak of 412km/s at 18/0228 UTC. Density was below average following arrival of the CME, before rising to near average. The Interplanetary magnetic field (IMF) strength, Bt, was moderate following the arrival of the CME, with a maxima of 10nT at 17/2020 UTC, which has now reduced to weak after the passage of the CME. The north-south component, Bz, was weak to moderately negative between 17/1200-1800UTC, then mostly positive. Phi angle varied periodically between positive (away from the Sun) and negative (towards the Sun) sectors. Resultant geomagnetic activity was mostly Quiet (Kp0-2).

**Energetic Particles / Solar Radiation:** High energy proton flux (greater than 10MeV) observed at GOES-18 was at background. High energy electron flux (greater than 2MeV) observed at GOES-16 was background to moderate. The associated 24-hour fluence remained below Active (1e8 integrated flux) with a value of 9.16e5 integrated pfu observed at 17/2359 UTC.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Moderate activity is forecast with occasional M-class flares likely and a slight chance of isolated X-class flares.

**Solar Wind / Geomagnetic Activity:** A CME that left the Sun on 15 Apr was expected to give a glancing impact at Earth early on Day 1 (18 Apr) and is now overdue, although this feature was

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low confidence. A second CME that occurred late on 16 Apr has been analysed as a likely miss below Earth' orbit on day 4 (21 Apr). Further CMEs associated with streams of plasma originating from AR3638 in the southeast may give some weak transient features towards or just beyond the forecast period, although confidence is low. Solar winds are currently at normal background speeds. A recurrent coronal hole high-speed stream is expected to become geoeffective on day 3 (20 Apr) likely increasing speeds to slightly elevated or elevated levels, continuing into day 4 (21 Apr), before gradually waning.

Geomagnetic activity is expected to be at mostly Quiet to Unsettled, with a slight chance of Active or G1/Minor Storm on day 1 (18 Apr) if any glancing CME arrives at Earth. Low confidence. Increasing to Unsettled to G1/Minor Storm levels during day 3 (20 Apr) due to the arrival of a HSS from CH25/-. On day 4 (21 Apr) activity is forecast to become Quiet to Unsettled.

**Energetic Particles / Solar Radiation:** High energy proton flux as observed by GOES-18 is forecasted to persist at background. High energy electron flux as observed by GOES-16 is expected to remain at background to moderate levels. The associated 24hr electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

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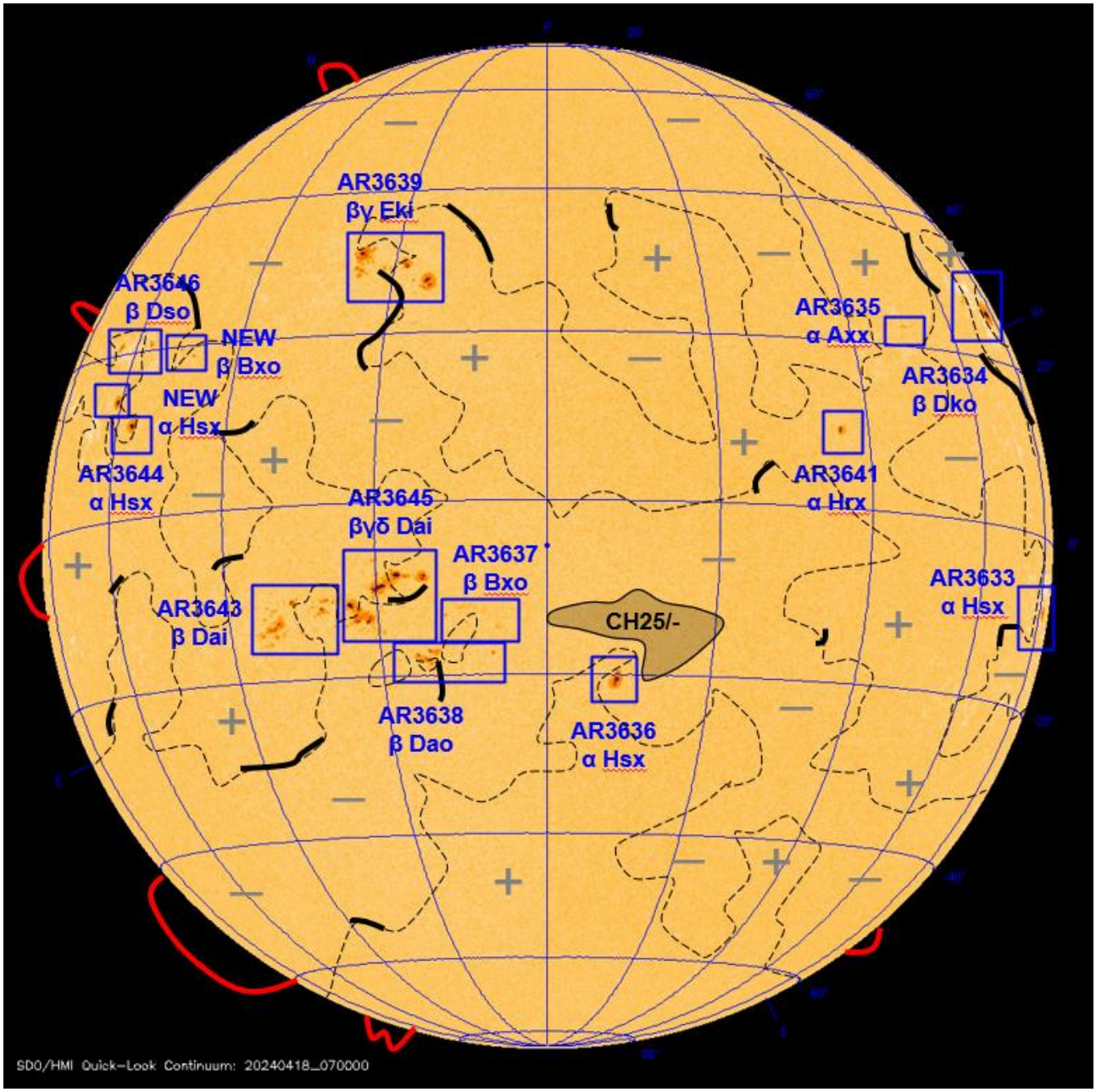
**Figure 1. Solar Analysis Valid 18/0700 UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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**Geomagnetic Storms:**

A CME that left the Sun following a flare and subsequent filament eruption from the southeast disc near AR3636 on 15 Apr was expected to give a glancing blow at Earth early on day 1 (18 Apr) but is now considered overdue and lower confidence. A large filament eruption from the southeast disc late on 16 Apr has been analysed as a likely miss below Earth orbit on day 4 (21 Apr).

Further CMEs (associated with Moderate-flares and a stream of plasma) were observed from an area near AR3638 late on 17 Apr and early on 18 Apr. These may have a minor Earth-directed component(s), which have been analysed and would only be expected to be observed as weak transients either on the 21 or 22 Apr.

Solar winds are currently at slow-ambient speeds. A minor enhancement from a glancing CME was anticipated early on day 1 (18 Apr), although there has been little evidence of this arriving, so far. This is now considered overdue, with any potential arrival likely to be a weak. Coronal hole 25 is expected to become geoeffective on day 3 (20 Apr). This is a persistent feature and gave peak speeds of around 550km/s on the previous rotation. The coronal hole itself appears smaller than on the previous rotation, though its equivalent position on the disc remains similar, so persistence forecasting for the onset carries moderately-high confidence, though likely with lower peak speeds than seen in March, estimated to be around 450-500km/s. This feature is not adequately modelled by Enlil presently.

Geomagnetic activity is expected to be at Quiet to Unsettled on day 1 (18 Apr), with a slight chance of Active, if any weak glancing CME arrives. Mostly Quiet on day 2 (19 Apr), before increasing to Unsettled to G1/Minor Storm levels on day 3 (20 Apr) due to the arrival of a coronal hole high-speed stream. On day 4 (21 Apr) activity is forecast at Quiet to Unsettled levels.

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 10 | 1 | 20 | 5 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

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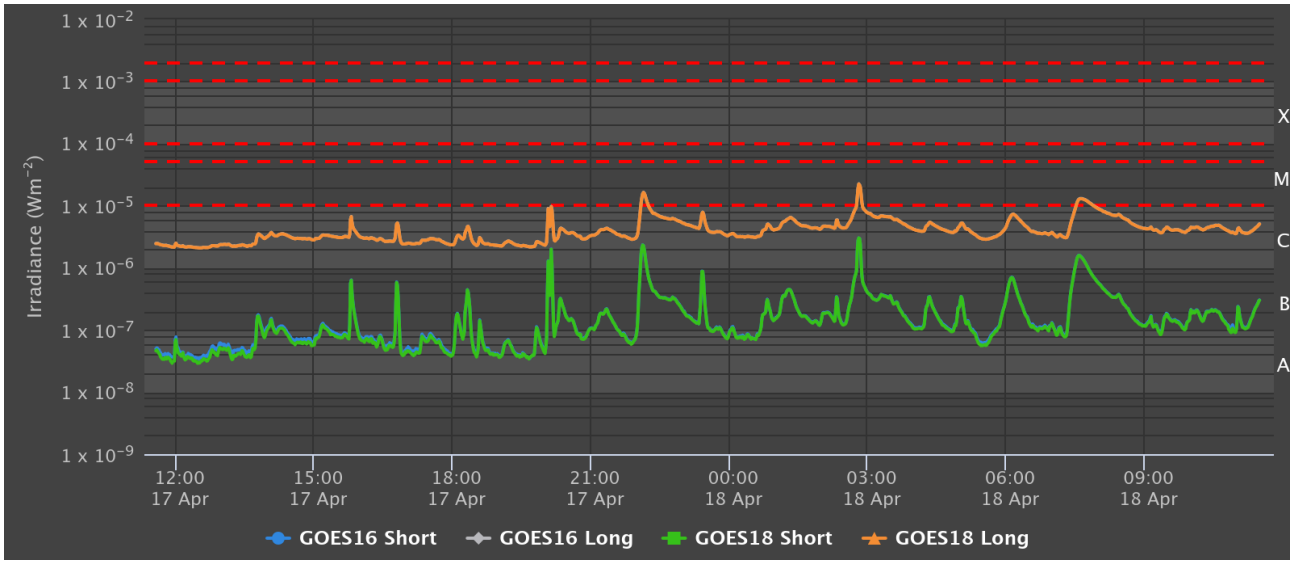
**Radio Blackouts - X-Ray Flares:**
Solar activity is currently Moderate with fourteen sunspot regions populating the visible disc and background flux well within C-class level. The largest region on the disc is now AR3635 in the southeast quadrant, with AR3639 the second largest in the northeast, which has shown some decay in the past 24 hours. The majority of recent activity has originated from the cluster of sunspots in the southeast, mainly AR3645 (Dai/Beta-Gamma-Delta). This region has exhibited modest growth with the development of a number of mixed polarity spots and a weak delta spot in the intermediate portion. The region lies close to several other sunspot groups and given the close proximity of these regions provides additional magnetic complexity to this area, which could elevate the likelihood of further significant flares should the regions persist.

Overall Moderate activity is forecast to continue, with occasional M-class flares likely and a slight chance of isolated X-class flares, the risk remaining consistent through the period pending further developments.

| X Ray Flares<br>Probability | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| Active | R1-R2 M Class | Yes | 70 | 70 | 70 | 70 |
| Very Active | R3 to R5 X Class | No | 10 | 10 | 10 | 10 |

**Figure 2: GOES X-Ray flux trace**

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## Solar Radiation Storms - (High Energy Protons):

High energy proton flux as observed by GOES-18 has persisted at background levels and is expected to generally remain so. There is a slight chance of the observed flux increasing in response to any notable flares however, primarily from AR3634 at first with this region moving towards the western limb. As the region rotates over the western horizon by day 3 (20 Apr) other regions currently in the eastern disc will be in a more favourable position for proton rich flares to be observed at GEO.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | ≥ S1 | No | 5 | 5 | 10 | 10 |
| Very Active | ≥ S3 * | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

## High Energy Electrons Event (≥ 2MeV):

High energy electron flux as observed by GOES-16 is expected to remain at background to moderate levels with enhanced geomagnetic activity expected to generally suppress values in the coming days.

The associated 24hr electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold, with current REFM output accepted as good guidance.

| GEO Electron Environment Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | ≥ 2 MeV ≥ $1x10^8$ | No | 1 | 1 | 1 | 1 |
| Very Active | ≥ 2 MeV ≥ $1x10^9$ | No | 1 | 1 | 1 | 1 |

**Figure 3: MOSWOC REFM electron fluence**

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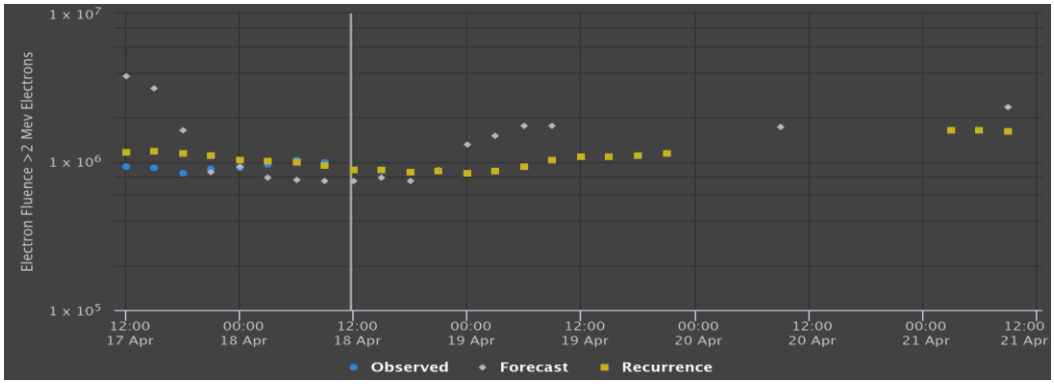


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